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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Applicant:		§		
	Cynthia S. Bell	§	Art Unit:	2675
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Serial No.:	09/524,029	§		
		§	Examiner:	M. Moyer
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For:	Automatic Brightness Control for Displays	§	Atty Docket:	ITL.0333US P8221
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Board of Patent Appeals & Interferences
Commissioner for Patents
Washington, D.C. 20231

APPEAL BRIEF

Sir:

Applicant respectfully appeals from the final rejection mailed July 16, 2002.

I. REAL PARTY IN INTEREST

The real party in interest is the assignee Intel Corporation.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF THE CLAIMS

Claims 1-3, 5-17, and 21-23 are rejected. Each rejection is appealed.

Date of Deposit: November 1, 2002
I hereby certify under 37 CFR 1.8(a) that this correspondence is being deposited with the United States Postal Service as **first class mail** with sufficient postage on the date indicated above and is addressed to the Commissioner for Patents, Washington DC 20231.

Cynthia L. Hayden

Cynthia L. Hayden

IV. STATUS OF AMENDMENTS

All amendments were entered.

V. SUMMARY OF THE INVENTION

Brightness is commonly defined as the magnitude of the visual sensation produced by light. Luminance is the magnitude of the light. Thus, according to one embodiment of the invention, the brightness setting for a display may be modified by first assessing the ambient luminance level and then using this assessment to select an appropriate display brightness setting.

In Figure 1, a system 100, such as a mobile information or communication device, includes a display 106. This display may be one of a variety of displays, such as a liquid crystal display (LCD), a plasma display, a backlit LCD, an organic light-emitting diode (OLED), to name a few.

In one embodiment of the invention, the system 100 includes an ambient light assessment block 102. The ambient light assessment block 102 may receive and quantify luminance information. The system 100 further includes a display brightness driver 200, which accepts the luminance information from the ambient light assessment block 102 in order to adjust the brightness of the display 106. The display brightness driver 200 may be implemented using hardware, software, or a combination of hardware and software.

In one embodiment of the invention, the system 100 includes a look-up table 108 in the display brightness driver 200. The look-up table 108 may be implemented in a storage device that stores values representing ambient luminance and corresponding values for setting the display brightness. These values may be predetermined as optimal values for a specific display's

output over a given range of light levels. See specification at page 2, line 24 through page 3, line 19.

The calibration operation is typically a final stage in the manufacture and test for a display. The results of the calibration test may then be stored in the LUT for the display. The LUT may thus include calibrated pairs of target output brightness and the respective drive signal level used to achieve the target output brightness.

In one embodiment of the invention, the system 100 is a processor-based system. The display brightness driver 200 may thus include software which is executable by the processor (not shown). The display brightness driver 200 may receive display brightness information from the look-up table 108, for example, for use in setting the brightness of the display 106. See specification at page 3, line 20 through page 4, line 13.

The ambient light assessment block 102 may comprise circuitry for quantifying incoming light. For example, in the embodiment of Figure 2, an ambient light assessment block 102a comprises a light meter circuit 110 and an analog-to-digital converter 120. The light meter circuit 110 receives incident light and quantifies the incoming energy as a voltage 116. The analog-to-digital converter 120 converts the voltage 116 to a digital value 122. The digital value 122 may then be sent to the display brightness driver 200, for setting the brightness of the display 106.

The light meter circuit 110 comprises a photoptic photocell 114, a diode 118, an op amp 112, and a resistor 124. Because the diode 114 receives incident light, with no voltage bias across the p-n junction, a photo current, I_{114}, thus flows from the diode 114 proportional to the received incident light.

To understand how the light meter circuit 110 operates, assume the op amp 112 is an ideal op amp. Op amps are extremely high gain circuits. The voltage difference between the inverting (-) and the non-inverting (+) inputs of the op amp 112 is very close to zero. The non-inverting input (+) of the op amp 112 is connected to ground. Accordingly, the voltage of the inverting input (-) is close to ground as well.

Since the voltage of the inverting input is close to zero, the current, I_{114}, flowing from the photodiode 114 is close to being equal to a current, I_{118}, flowing from the diode 118, applying well-known circuit equation rules.

Since the voltage across a diode is approximately the logarithm of the current through the diode, the voltage 116 is approximately the logarithm of the current, I_{118}, and, therefore, the current, I_{114}. Thus, the light meter circuit 110 produces a voltage 116 which is a logarithm proportional to the incoming light intensity.

The resistor 124 is coupled to the photodiode 114. This feedback of the light meter circuit 110 controls the impedance of the output voltage 116. By having a circuit 110 which produces a logarithmic output, a much broader range of intensity may be measured than would be possible using a linear circuit. See specification at page 4, line 14 through page 5, line 16. / good

Returning to Figure 1, in one embodiment of the invention, the look-up table 108 contains the display brightness driver control settings that have been optimally predefined for the range of light levels. Once a light level, as measured by the light meter circuit 110 of Figure 2, for example, is matched to the nearest index reference value of the look-up table 108, the table entry may be read as the new brightness for the display 106.

For some products, the ambient light assessment block 102 may use circuitry which is already available for other purposes. For example, for image capture devices such as charged

coupled device (CCD) cameras or complementary metal oxide semiconductor (CMOS) imagers, circuitry which adjusts exposure settings, for example, may be used to assess ambient luminance levels.

For example, an imaging device may include a plurality of photocells, arranged as an array of sensors. The sensors accumulate energy from the incident light. At the end of an integration interval the sensors produce an indication of the accumulated energy, such as an analog voltage value. The accumulated energy is also the intensity of the light received by each sensor.

These imagers are designed to take good pictures. The best pictures are usually taken after the exposure parameters have been adjusted according to the amount of light in the scene being shot. If the accumulated energy of one or more sensors is too high (e.g., is over-exposed), the integration time may be decreased. Likewise, for sensors which are under-exposed, the integration time may be increased. This process may be repeated as needed. Once an appropriate integration time is determined, the imaging device may take a good picture. See specification at page 5, line 17 through page 6, line 15. /

The ambient luminance may also be evaluated once the integration time has been realized. The relationship between luminance and integration time is shown by the following formula:

$$L = KA^2/(TS)$$

where the luminance, L, is in candelas per square meter (cd/m^2), K is a constant, A is the aperture of the taking lens in meters, T is the integration time of the imager in seconds (sec), and S is the effective ISO speed as defined by the International Standards Organization (ISO). Since

K, A, and S are typically constant for a given device, the equation shows that luminance is inversely related to the integration time.

Turning to Figure 3, in a second embodiment of the invention, an ambient light assessment block 102b may comprise an imager 150, for receiving ambient light as well as a control block 154, for calculating the integration time. In Figure 3, the ambient light assessment block 102b may be part of a digital camera, for example. The ambient light assessment block 102b thus uses circuitry already adapted to performing exposure adjustment, as described above. The imager 150 may electrically capture an optical image (not shown). The imager 150 includes an array of photon sensing sensors 152. During an integration time, each sensor 152 typically measures the intensity of a portion of a representation of the optical image that is focused onto the imager 150. At the end of the integration time, as described above, the energy accumulated onto the sensor 152 is sent to the control unit 154 as a discrete value, such as an analog voltage. See specification at page 6, line 16 through page 7, line 11.

The control unit 154 may adjust the integration time for the sensors 152 such that the imager 150 is set to the proper exposure. In one embodiment of the invention, the control unit 154 sends an integration time value 156 to the display brightness driver 200 (Figure 1). In the display brightness driver 200, for example, software may include the above formula to derive the ambient luminance, based upon the integration time value 156 received from the control unit 154.

The display brightness driver 200 may use the calculated ambient luminance value as an index into the look-up table 108, which may, in turn, provide a corresponding display brightness value. Using this value, the display brightness driver 200 may adjust the brightness of the

display 106. In this manner, the circuitry used to adjust the exposure of the device may also be exploited to adjust the brightness of the display 106.

The look-up table 108 provides a translation between the ambient luminance level and the desired display brightness. In one embodiment of the invention, the look-up table values are derived based upon two eye adaptation processes which take place. First, direct adaptation is the slow sensitivity adjustment of the eye to the average luminance of whatever is being intently viewed. Second, lateral adaptation is a faster process in which the eye reacts to the average luminance of the environment.

If the display 106 of the system 100, for example, is adjusted according to the ambient luminance at all times, then the average luminance of whatever is being viewed (the display 106) and the average luminance of the environment will be the same. In other words, there will be no conflict between the direct and lateral adaptations for the viewing eye. This enables the viewer to immediately perceive information on the display 106 without experiencing a delay for adaptation.

Likewise, once the viewer stops looking at the display, the ability to quickly see objects external to the display is preserved. Thus, any safety issues due to re-adaptation, such as temporary visual impairment, may be avoided. See specification at page 7, line 12 through page 8, line 14. /good

In one embodiment of the invention, a perceived brightness value may be calculated such that conflicts between direct and lateral adaptations of the viewer's eye are avoided. Using different ambient luminance values, the perceived brightness may be calculated, providing entries for the look-up table 108. The relationship for perceived brightness versus scene luminance is:

$$B = AL^{1/3} - S$$

where $A = 100/(L_{AVG}^{1/3} + K)$ and $S = 100(\ S_iA_iL_i^{1/3})$.

B is the perceived brightness in LUX, A is the direct adaptation effect, L, L_i and L_{avg} are environmental luminances in cd/m^2, K is 3.6, and S is the lateral adaptation effect made up of the sum of weighted adaptations to spot luminances in proportion to their angular displacement from the axis of vision. See specification at page 8, line 15 through page 9, line 7.

In Figure 6, a flow diagram illustrates the operation of the display brightness driver 200 of Figure 1, according to one embodiment of the invention. The system 100 receives ambient light, quantifies the information received, and digitizes the information as a discrete value, such that the display brightness driver 200 may interpret the data (block 202). The discrete value may, for example, be used as an index into the look-up table 108 (block 204). In the look-up table 108, a display brightness adjustment value associated with the index value, is determined (block 206). Using the display brightness value, the display brightness driver 200 may then adjust the display 106 (block 208). See specification at page 11, line 1 through page 12, line 7.

VI. ISSUES

A. Is Claim 1 Obvious Over Helms in View of Hosoi?

B. Is Claim 8 Anticipated by Helms?

C. Is Claim 21 Obvious Over Helms in View of Hosoi?

D. Is Claim 22 Obvious Over Helms in View of Hosoi?

VII. GROUPING OF THE CLAIMS

For convenience on appeal, claims 2-7 may be grouped with claim 1, claims 9-17 may be grouped with claim 8, and claim 23 may be grouped with claim 22.

VIII. ARGUMENT

A. Is Claim 1 Obvious Over Helms in View of Hosoi?

Claim 1 calls for "automatically adjusting a brightness for the display based upon the indicator." The indicator is defined in claim 1 as being determined "based upon the integration time." Thus, the idea here is that the integration time may be utilized as an indicator to determine display brightness.

Neither of the cited references, nor their combination, teaches this feature. While the Examiner contends that one of the cited references does some type of integration, it does it in connection with capturing an image, not for determining the brightness of the display. 1

Even if that information could conceivably be converted using some type of technique to a format suitable for controlling display brightness, neither of the cited references and, therefore, their combination, teaches the claimed invention. In short, nobody ever thought to use the integration time to control display brightness. ?

The reference that relates to controlling the brightness of a display does not use an integration time, and the reference that relates to integration time inapplicably teaches how to use the integration time to determine the intensity of ambient light. But, this is still one step short of converting that information in some way to a form useful for controlling display brightness. 2

The information from Hosoi cannot be directly incorporated into Helms. Some translation would be required. There is no teaching of anybody ever thinking of a reason to

make that translation. Therefore, the combination of references is missing an important claimed element.

As a result, the rejection of claim 1 should be reversed.

B. Is Claim 8 Anticipated by Helms?

Claim 8 calls for correlating detected light levels with display brightness levels and incorporating this information in the display driver itself.

Claim 8 was rejected under Section 102 over the Helms patent.

Claim 8 calls for a system including a receiver of light information to produce an indicator and a driver coupled to the receiver. The driver receives the indicator and, based on the indicator, automatically sends a signal to control the brightness of a display.

In Helms, an auto brightness control uses a look-up table. In the claimed invention, the output of a luminance sensing circuit is sent to a display driver chip's brightness control input. The calibration operation in manufacturing develops the data to build the look-up table, correlating detected light levels with display brightness levels, and incorporating this in the display driver itself. This leverages the display's factory calibration step, which also comprehends co-calibration of the light sensing circuit. See Specification at page 3, line 14 - page 4, line 2.

The claimed system is particularly well adapted for lower cost devices. The claimed invention would result in lower cost because fewer parts may be needed and the manufacturing process may be leveraged to make the system work.

Nothing in Helms suggests doing so in the display driver itself and, therefore, claim 8 distinguishes over the Section 102 rejection based on the Helms patent.

The anticipation rejection should also be reversed.

C. Is Claim 21 Obvious Over Helms in View of Hosoi?

Claim 21 calls for a system in which a display brightness control receives ambient light information from an imager and adjusts the display brightness based on that information. The Examiner contends that Hosoi can be construed as an imager because it is able to take a picture with instant film 10. However, of course, the claim calls for receiving ambient light information from the imager. In this case, the instant film camera really has no imager and if it had an imager, it does not convey ambient light information for display brightness.

Essentially, the Examiner begs the invention which is receiving ambient light information from the imager and it simply says, I'll call a film device an imager when, of course, it is not an imager and the film portion of the device has no impact on receiving ambient light information and providing that information to a brightness control.

Therefore, the rejection of claim 21 should be reversed.

D. Is Claim 22 Obvious Over Helms in View of Hosoi?

Claim 22 calls for a driver coupled to the display brightness control wherein the driver receives an indication of light brightness and, based on the indication, automatically sends a signal to control the brightness of the display.

The cited reference does not even disclose a driver, much less a driver that does what is called for in the claim.

Therefore, claim 22 patentably distinguishes over the references.

IX. CONCLUSION

Applicant respectfully requests that each of the final rejections be reversed and that the claims subject to this Appeal be allowed to issue.

Respectfully requested,

Date: November 1, 2002

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APPENDIX OF CLAIMS

The claims on appeal are:

1. A method comprising:

receiving an indicator of the ambient light for a system having a display by accumulating energy into a plurality of sensors of an imager, deriving an integration time based upon the accumulated energy and determining the indicator based upon the integration time; and

automatically adjusting a brightness for the display based upon the indicator.

2. The method of claim 1, further comprising:

using the indicator as an index into a look-up table.

3. The method of claim 1, wherein receiving the indicator of the ambient light further comprises using a light meter circuit.

5. The method of claim 2, further comprising:

receiving a brightness value for the display from the look-up table.

6. The method of claim 1, wherein accumulating energy comprises producing an analog voltage signal.

7. The method of claim 3, wherein using the light meter circuit comprises producing a logarithmic representation of the incident light received.

8. A system, comprising:

a receiver of light information to produce an indicator; and

a driver coupled to the receiver, wherein the driver receives the indicator, and, based upon the indicator, automatically sends a signal to control a brightness of a display.

9. The system of claim 8, further comprising:

a display coupled to the driver, wherein the display receives the signal.

10. The system of claim 8, further comprising:

a look-up table in the receiver, comprising a plurality of values corresponding to the light information and a plurality of values corresponding to the indicator.

11. The system of claim 10, wherein the driver receives the indicator from the look-up table.

12. The system of claim 10, wherein the plurality of values and the plurality of indicators in the look-up table are based upon a display type.

13. The system of claim 12, wherein the display type is a direct view liquid crystal display.

14. The system of claim 13, wherein the display type is a microdisplay.

15. The system of claim 8, wherein the receiver is a mobile communications device.

16. The system of claim 8, wherein the receiver is a mobile information device.

17. The system of claim 8, wherein the indicator is a voltage from a sensor.

21. A system comprising:

a processor;

a display coupled to said processor;

an imager; and

a display brightness control that receives ambient light information from the imager and adjusts the display brightness based on said information.

22. The system of claim 21 including a driver coupled to said display brightness control, wherein the driver receives an indication of light brightness and based upon the indication automatically sends a signal to control the brightness of the display.

23. The display of claim 22 including a storage coupled to said processor, said storage including a look-up table comprising a plurality of values corresponding to the light information.